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Chapter Three

Aristotle and the End of Classical Greek Philosophy

"The greatest thinker of antiquity," Marx called him. Aristotle lived from 384 to 322 B.C., and was born, not in Athens but in Stagira, Thrace. Originally a pupil of Plato, he made a thorough study of his philosophy over a period of twenty years, but evidently became dissatisfied with it. After Plato's death, he left the Academy and later became the tutor of Alexander. He returned to Athens in 335 B.C., to found his own school, the Lyceum. His was an encyclopaedic mind, encompassing a huge number of

subjects—logic, rhetoric, ethics, political sciences, biology, physics and metaphysics ("what comes after physics," the study of first principles and presuppositions). He is the real founder of logic, natural history, the theory of morals, and even of economics.

The philosophy of Aristotle marks a sharp break with that of Plato. In many ways it is diametrically opposed to it. Instead of the idealist method, which turns its back upon reality in order to take refuge in a world of perfect ideas and forms, Aristotle proceeds from the concrete facts of sense perception, and from these arrives at ultimate grounds and principles. Whereas Plato started

with ideas, and tried to explain reality from them, Aristotle sets out from reality, carefully examining a large number of facts and phenomena, in order to derive from them a series of general inferences. That is to say, he used the method of induction.

Aristotle's interest in physics and biology is an illustration of his general approach, his love of experiment and observation as the main source of knowledge. In this, he was a pioneer of the modern scientific method. When Alexander the Great was engaged on his wars of conquest, he arranged to send back to Aristotle details and drawings of all new discoveries of plants and

animals. What a difference to Plato, who regarded the crude material world of nature as unworthy of his attention!

Aristotle spent many years collecting, arranging, and classifying information from all manner of spheres.

Aristotle, however, did not merely collect facts. Basing himself on information derived from the objective material world, he proceeded to generalise. In his most profound work, the *Metaphysics*, he speculates on the meaning of universal notions. In the process, he sums up and criticises previous philosophies, and therefore may also be regarded as the first historian of philosophy. It should be

borne in mind that this has nothing to do with the use of the word "metaphysics" in the writings of Marx and Engels, where it is used in an entirely different sense—as a way of describing the narrow mechanical outlook of the non-dialectical materialist philosophers of the 18th and 19th centuries. In fact, the "metaphysics" of Aristotle occupies a similar place to dialectics in the philosophy of Plato.

In the *Metaphysics*, Aristotle for the first time provides a systematic account of some of the basic categories of dialectics. This fact is often overlooked, because he also laid down the laws of formal ("Aristotelian") logic, which, at

first sight, appear to stand in contradiction to dialectics. In point of fact, for Aristotle, logic and dialectics were both valid ways of thinking. This is, in fact, the case. Dialectical thinking does not contradict formal logic, but complements it. More correctly, the laws of formal logic hold good within certain limits, beyond which they break down. In particular, formal logic, based on the law of identity, cannot adequately deal with motion, which involves a contradiction—something which formal logic explicitly rules out. For a whole series of operations in everyday life, the rules of formal logic hold good and play a useful role. But when the attempt is made to apply these laws and thought-

forms to areas where they conflict with reality, they turn into their opposite. Far from helping us to understand the workings of nature, they become an endless source of error, holding back the development of science and knowledge.

The whole of formal logic is based on three propositions, which make up the basic Aristotelian syllogism:

- 1) the law of identity ("A" = "A")
- 2) the law of contradiction ("A" is not "not-A"), and
- 3) the law of the excluded middle ("A" is not "B")

For more than 2,000 years, this has been the corner-stone of all logic. Towards

the end of the 18th century, Kant was able to say that logic, since Aristotle, had not made any step forward or any step back. Despite all the changes experienced by science in that period, the rules of logic remained petrified, in the forms worked out by Aristotle, and later converted into a dogma by the mediaeval Church. Yet the basic Aristotelian syllogism upon which the whole edifice is constructed is based on a false premise. In the first place, despite the appearance of a logical progression, this is an illusion. All three assertions are, in fact, already contained in the first one, "A" is "A." Everything stands or falls with this, the "law of identity."

At first sight, the truth of this proposition would appear to be self-evident. Like the law of contradiction, which is merely a negative way of saying the same thing, it seems to brook no dissent. "There are some who maintain (a) that the same thing can be and not be, and (b) that it is possible so to judge. Many physicists too, have used language to this effect. Now we have just assumed that a thing cannot both be and not be, and have also shown this to be the most indubitable of all principles. The demand that we should prove the law argues a defective education in logic—a science which enables one to recognise what requires proof and what does not. It is absolutely impossible to have proof

of everything: the process would continue indefinitely, and the result would be no proof of anything whatsoever. Granted, on the other hand, that there are some things which do not call for proof, what principle, I ask, is more self-evident than the law of contradiction?" (Aristotle, *Metaphysics*, p. 125.)

It is interesting to note that here Aristotle, who is normally most concerned to prove each of his postulates by a rigorous process of argument, makes no attempt to prove the law of contradiction, but merely asserts it dogmatically. It is just to be accepted as "common sense." But, upon closer

examination, the matter is not at all as simple as it is presented. In real life, a thing is and is not equal to itself, because it is constantly changing. You are in no doubt that you are you. But in the time you have taken to read these lines, billions of changes have taken place in your body—cells have died and been replaced. The body consists of tissue, which is constantly breaking down and being replaced, eliminating waste matter and bacteria, excreting carbon dioxide through the lungs, losing water in sweat and urine, and so on. These constant changes are the basis of all life. They mean that, at any moment, the body is itself and also something different to itself. So you are not the

same person you were. Nor is it possible to get round this by arguing that you are you at this precise moment in time, since even in the smallest portion of time, change takes place.

For normal purposes, we can accept that " $A = A$," that you are you, and nobody else. The reason is that the kind of change we are referring to is so small that it can be ignored for normal purposes. However, over a longer period, twenty years, for instance, a difference would be noticed. And in a hundred years, the difference would be quite sufficient for one to conclude that you are not you at all! Moreover, this does not only apply to living things.

Inorganic matter is also in a state of constant change, so that everything is and is not, because, to use Heraclitus' marvellous expression "everything is in flux."

For ordinary everyday purposes, we can accept the law of identity. Indeed, it is absolutely indispensable, if thought is not to dissolve into utter confusion. But for more accurate calculations, or higher velocities approaching the speed of light, or for a whole series of critical situations, it proves inadequate. At a certain point, an accumulation of small, quantitative changes gives rise to a fundamental change in quality. All of this remains a closed book to formal logic,

the fundamental weakness of which is an inability to deal with things in their movement and life.

Similarly with the law of the excluded middle, which states that it is necessary either to assert or deny, that a thing must be either black or white, either alive or dead, either "A" or "B." It cannot be both at the same time. For normal everyday purposes, we can take this to be true. Indeed, without such assumptions, clear and consistent thought would be impossible. In the period of decadence of sophism, it became customary to play with dialectics in an arbitrary way, which so twisted the method of reasoning as to be able to

prove practically any opinion. Aristotle was determined to clear up the mess caused by the subjective dialectics of sophism, hence his insistence on elementary logical propositions.

Nevertheless, when we depart from the realm of everyday experience and consider more complex processes, it is by no means such a simple matter to distinguish "A" from "B." The dogmatic insistence on eliminating contradiction leads precisely to the metaphysical mode of thought in the specific sense understood by Marx and Engels, as explained in *Anti-Dühring*, which points out the limitations of the laws of formal logic when faced with the contradictory

reality of nature:

"To the metaphysician, things and their mental images, ideas, are isolated, to be considered one after the other and apart from each other, fixed, rigid objects of investigation given once for all. He thinks in absolutely unmediated antitheses. 'His communication is 'yea, yea; nay, nay'; for whatsoever is more than these cometh of evil.' For him a thing either exists or does not exist; a thing cannot at the same time be itself and something else. Positive and negative absolutely exclude one another; cause and effect stand in a rigid antithesis one to the other.

"At first sight this way of thinking seems to us most plausible because it is that of so-called sound common sense. Yet sound common sense, respectable fellow that he is in the homely realm of his own four walls, has very wonderful adventures directly he ventures out into the wide world of research. The metaphysical mode of thought, justifiable and even necessary as it is in a number of domains whose extent varies according to the nature of the object, invariably bumps into a limit sooner or later, beyond which it becomes one-sided, restricted, abstract, lost in insoluble contradictions, because in the presence of individual things it forgets their connections; because in the

presence of their existence it forgets their coming into being and passing away; because in their state of rest it forgets their motion. It cannot see the wood for the trees. For everyday purposes we know and can definitely say, e.g., whether an animal is alive or not. But, upon closer inquiry, we find that this is sometimes a very complex question, as the jurists very well know. They have cudgelled their brains in vain to discover a rational limit beyond which the killing of the child in its mother's womb is murder. It is just as impossible to determine the moment of death, for physiology proves that death is not a sudden instantaneous phenomenon, but a very protracted

process.

"In like manner, every organic being is every moment the same and not the same; every moment it assimilates matter supplied from without and gets rid of other matter; every moment some cells of its body die and others build themselves anew; in a longer or shorter time the matter of its body die and others build themselves anew in a longer or shorter time the matter of its body is completely renewed and is replaced by other molecules of matter, so that every organic being is always itself, and yet something other than itself.

"Further, we find upon closer

investigation that the two poles of an antithesis, like positive and negative, are as inseparable as they are opposed, and that despite all their opposition, they interpenetrate. In like manner, we find that cause and effect are conceptions which only hold good in their application to the individual case as such; but as soon as we consider the individual case in its general connection with the universe as a whole, they merge, they dissolve in the concept of universal action and reaction in which causes and effects are constantly changing places, so that what is effect here and now will be cause there and then, and vice versa.

"None of these processes and modes of thought fit into the frame of metaphysical thinking. But for dialectics, which grasps things and their conceptual images essentially in their interconnection, in their concatenation, their motion, their coming into and passing out of existence, such processes as those mentioned above are so many corroborations of its own procedure." (Engels, *op. cit.*, pp. 26-7.)

It is unfortunate, but not unique, that the brilliant, original thought of a genius became ossified and impoverished in the hands of his successors. The flexible, dialectical aspect of Aristotle's method, with its emphasis on observation and

experiment was lost sight of for a long time. The mediaeval Schoolmen, interested only in providing an ideological basis for the doctrines of the Church, concentrated on his logic, interpreted in a lifeless and formalistic way, to the exclusion of practically all else. Thus, a body of ideas which ought to have provided a healthy stimulus to the development of science, was turned into its opposite—a set of chains for the intellect, which was only shattered by the revolutionary upsurge of the Renaissance.

There is something profoundly ironical about the hijacking of Aristotle by the Church. In fact, his writings are

impregnated with a strongly materialist spirit. Lenin considered that "Aristotle comes very close to materialism." (Lenin, Collected Works, Vol. 38, p. 282.) Thus, unlike Plato, in Aristotle, formal logic is closely connected to the theory of being and the theory of knowledge, because he saw the forms of thought as being, not independently existing phenomena, but forms of being, expressed in human consciousness.

Aristotle totally rejected Plato's theory of ideas as disembodied forms. The aim of science is, of course, to generalise on the basis of experience. But the general only exists in and through the material things given to us in sense perception.

He rightly understood the limitations of the early materialists like Thales who attempted to express the material world in terms of a single concrete manifestation, such as water. He saw matter as an eternal substance, which is always changing, which cannot be created or destroyed, with neither beginning or end, but which is in a constant process of change and transformation. One of his main objections to Plato's idealism is that non-material ("non-sensible") things can have no movement: "But this is quite inadmissible; a heaven...without movement is unthinkable; yet a non-sensible heaven can have no movement." (Aristotle, *Metaphysics*, p. 94.)

Aristotle's penetrating mind detected an insoluble contradiction in Plato's idealism. If there really existed unchanging, eternal forms, how did they succeed in giving rise to the constantly moving, changing material world we see before us? Out of such an immobile idea, entirely devoid of any principle of motion, one can derive nothing at all, except a complete standstill. Nothing comes into being, without a moving force, either from within itself or from without, as Newton found out, when he assigned God the task of providing the initial impulse to get his mechanical universe moving. But here there is nothing of the sort. Plato's Ideas have no motion in them. But since all things

move and change, these allegedly perfect ideas suffer from the greatest imperfection of all. They do not exist. More correctly, they do not exist anywhere except as phantoms in the brains of philosophers.

The absolute separation between thought and being, that peculiar schizophrenia which afflicts all brands of idealism ultimately leads it to impotence, since there is no real way in which the Absolute Idea which is supposed to stand above the world of crude material reality can affect the latter, or impinge upon it in any way whatever. As Schwegeler remarks:

"The supporters of the Ideal Theory, then, are not in a position logically to determine any idea; their ideas are indefinable. Plato has left in complete obscurity the relation in general of things to the ideas. He terms the ideas archetypes, and supposes things to participate in them; but such expressions are only hollow poetical metaphors. How are we to conceive this 'participation' in, this copying of, these patterns thus remote, absent in an alien region? It is in vain to seek in Plato any definite explanation here. It is wholly unintelligible how and why matter comes to participate in the ideas." (Schwegler, *op. cit.*, p. 104.)

In his struggle against the subjectivism of the sophists, Socrates laid stress on the need to look for universal ideas, and arrive at correct conceptions and definitions which really correspond to the subject matter under consideration. This was an advance as against the arbitrary method of the sophists. Indeed, without such universals, science in general would be impossible. However, Plato's attempt to transform these general notions into independent entities led straight into the swamp of religious mysticism. What we are really dealing with here, under the heading of "universals" is the genus and species of things. The notion that a genus or species can exist separate and apart from the

individuals that comprise it, or vice versa, is a self-evident nonsense. Aristotle rejected the notion that forms and ideas can exist separate from material things:

"While the Ideal Theory involves us in numerous difficulties, its greatest absurdity is the doctrine that there are entities apart from those in the sensible universe, and that they are the same as sensible things except that the former are eternal while the latter are perishable. Those who uphold this view are saying in effect that there is an absolute Man, and Horse, and Hearth. They follow closely in the footsteps of those who teach that there are gods, but in human

form; for as the latter merely set up eternal men, so the former do no more than make the Forms eternal sensibles." (Aristotle, *Metaphysics*, pp. 93-4.)

With enormous patience and intellectual rigour, Aristotle went through all the categories of thought, which he expressed in a far more developed and explicit way than had hitherto been the case. Many of the categories of dialectical thought later developed in Hegel's *Logic* are already dealt with in outline by Aristotle—Being, Quantity and Quality, Part and Whole, Necessity and Accident, Potential and Actual, and so on. There are many important insights here. For example, in the discussion of

the relation between potentiality ("dynamis") and actuality ("energeia"), Aristotle anticipates the idea of the unity of matter and energy. For Aristotle, matter consists of two aspects, substance, which contains within itself the potential for an infinite number of transformations, and a kind of active principle, "energeia," which is an innate and spontaneous moving force. In developing the idea of the movement of potential being into actual being, Aristotle gives a more concrete version of the "becoming" of Heraclitus. Here we have the main point of difference between the philosophy of Aristotle and that of Plato. In place of the static, lifeless Idea, we have an inherent

tendency of matter towards movement and development, which realises itself by constantly passing from potentiality to actuality.

In relation to time, Aristotle shows himself to be superior, not only to Plato, but to many modern scientists, who talk mystical nonsense about the "beginning of time." He points out that time, like motion, has always existed, and that, consequently, it is absurd to talk of the beginning or end of time:

"It is impossible, however, that motion should be generable or perishable; it must always have existed. Nor can time come into being or cease to be; for there

cannot be a "before" or "after" where there is no time. Movement, then, is also continuous in the sense in which time is, for time is either the same thing as motion or an attribute of it." (Ibid., p. 342.) This is a profound thought, and one that anticipates the position of dialectical materialism, that time, space and motion are the mode of existence of matter, although Aristotle was unable to develop this idea in a satisfactory way.

Starting out from the position of objective idealism, Aristotle came quite close to materialism, although he never managed to make a complete break; as Lenin comments, he wavered "between idealism and materialism." (Lenin,

Collected Works, Vol. 38, p. 286.) In the writings of Aristotle, we find the germs of a materialist conception of history and the development of thought and culture. He explains that, while the actions of animals are determined by immediate sense-impressions (the things they can see, hear, etc.) and memory, only the human race lives by shared, social experience, art and science. While the starting point of all knowledge is experience and sense-perception, that is not enough:

"Wisdom, again, is not to be identified with sense-perception which, though it is our primary source of knowledge of particulars, can never tell us why

anything is so (e.g., why fire is hot), but only that it is so." Aristotle, op. cit., p. 52.)

The theory of knowledge of Aristotle also comes close to a materialist position. The starting point is the facts and phenomena given to us through our senses (in sense-perception), passing from the particular to the universal, "so that in this case we have to start from what is more intelligible to ourselves (i.e., the complex facts and objects of experience) and advance to the understanding of what is of its nature intelligible (i.e., the simple, universal principles of scientific knowledge)." (Ibid., p. 172.)

The inconsistency of Aristotle's position is revealed in the concessions he makes to religion, in assigning to God the role of the First Cause. Anticipating Newton, he argued that there must be something which originates motion, and this something must itself be unmoved. This "something," however, must be an eternal substance and actuality. The concept is ambiguous, rather like the "substance" of Spinoza. It is open to the same objections levelled by Aristotle against Plato. For if the universe was once without motion—something which is impossible—there is no way it could be made to move, unless by an external impulse. But if the "unmoved First Mover" is not material, it is impossible

that it should impart motion to a material universe.

Moreover, this line of argument does not solve the problem posed, but merely shifts it back one stage. Let us accept that the "First Cause" set the universe in motion. What caused the "First Cause"? This question is not supposed to be asked. The answer is allegedly given in advance by the phrase "unmoved First Mover," which, of course, answers nothing. The weakness of the whole argument is self-evident, and flows from Aristotle's preoccupation with the search for final causes (as opposed to what he called material, formal and efficient causes). Within certain limits,

for everyday purposes, it is possible to do this with a fair degree of satisfaction. For example, the causes of the existence of a house can be traced to the building materials, the builders, the architect, and so on.

In fact, however, it is possible to go on tracing the causes of even the simplest phenomenon indefinitely. Even in the given example, we could go on to specify the demand for housing, the state of the world economy, the atomic composition of the bricks and cement, the parents and grandparents of all the people involved, and so on and so forth. For practical purposes, we choose not to do this, placing a definite limit on

causality. But, in reality, the chain of causation is endless, cause becoming effect, and vice versa, ad infinitum. Thus, the very conception of a "First Cause" is unscientific and mystical. Naturally, this weakest side of Aristotle was seized upon and elevated to the rank of dogma by the Church.

Another misconception in Aristotle, related to the above, was the teleological interpretation of nature. Teleology (from the Greek word telos, an end) holds that all natural phenomena, including man, are determined by an ultimate goal or purpose. This mistaken notion played a negative role in holding back science, since it cannot really

explain anything. Moreover, it leads to religious conclusions, because one has to say where this "purpose" came from. The conclusion is drawn that the goal of things is determined by God.

Aristotle himself did not approach things in this way, although it suited the Church later on to give it a religious interpretation. To him, everything contained within itself an active principle, or "soul" ("entelechy"), and the whole of nature is guided by a single supreme goal. This idea probably comes from Aristotle's investigations of biology. In his works, he mentions some 500 different types of animals, of which he himself dissected about fifty different

types. From close observation, he noted how the body structure of animals is perfectly adapted to their environment and mode of existence. From such observations, Darwin arrived at the theory of evolution. But Aristotle drew a different conclusion, namely that the nature of each animal is predetermined by Nature in accordance with a given order, a plan almost, which is inherent in the nature of things. Thus, Aristotle ascribes the body to a divine plan:

"Man alone of all the animals is erect, because his nature and his substance are divine. To think, to exercise intelligence, is the characteristic of that which is most divine. This is not easy if much of the

body is situated in the upper part. For weight renders the exercise of thought and perception sluggish. Accordingly, if the weight and the bodily element increase, bodies must bow down to earth; then, for security, nature must substitute forelegs for hands and arms, and we get quadrupeds...But man being erect has no need of forelegs; instead of them nature has given him hands and arms. Now Anaxagoras has said that it is the possession of hands that has made man the most intelligent of the animals. The probability is that it was because he was the most intelligent that he got hands. For hands are a tool, and nature, like an intelligent man, always distributes tools to those that can use

them. The proper thing is to give a genuine flute-player a flute rather than to give a man who happens to have a flute the skill to play, for that is to add the lesser to the greater and more august instead of adding the greater and more precious to the lesser. If, then, it is best that it should be so, and if nature, out of what is possible always does the best, it is not because he has hands that man is wise, but because he is the wisest of the animals he has hands." (From *Parts of Animals*, quoted in Farrington, p. 129-130.)

The idea of Anaxagoras, that the development of human intelligence was made possible by the freeing of the

hands was a marvellous insight, but Aristotle completely stands it on its head. His teleological approach prevented him from arriving at a genuinely scientific appraisal of nature, in spite of the vast extent of his researches. Taken over by Thomas Aquinas and the Church, it held back the study of nature for centuries, until Darwin's discoveries gave a rational explanation of the relative purpose of living creatures. Even so, teleological conceptions in biology resurfaced in different guises—neo-vitalism, neo-Lamarckism, etc. The same tendency is often expressed even today by people who, when attempting to describe natural phenomena, unconsciously

endow "Nature" with human characteristics, as if it "made" animals and plants, and got them to behave in a certain way. In reality, the "purposefulness" displayed by plants and animals is the process of optimum adaptation of living objects to their surroundings, and not at all the product of a preordained plan.

Greek Science in the Alexandrine Period

The barrenness of idealist philosophy is shown by the fact that it was incapable of further development. Plato's philosophy ended with the death of Plato. His Academy was taken over by a

series of second-raters, who contributed nothing new to the development of thought. This was not the case with Aristotle's Lyceum. His emphasis on investigation stimulated his pupils to engage in fruitful practical research. The voluminous studies in different fields bequeathed by the Master laid the basis for the development of various sciences. The great museum of Alexandria was an offshoot of the Lyceum, which produced important treatises on botany, physics, anatomy, physiology, mathematics, astronomy, geography, mechanics, music and grammar.

Aristotle's first successor, Theophrastus, made a breakthrough in biology, being

the first to draw a firm distinction between plants and animals to establish the science of botany. Theophrastus also began to question the validity of teleology, and proposed to place a limit on its application to biology:

"We must try to set a limit on the assigning of final causes," he wrote.

"This is the prerequisite of all scientific inquiry into the universe, that is, into the conditions of existence of real things and their relations with one another." (See Farrington, p. 162.)

He went back to the materialist explanations of the pre-Socratic philosophers, in order to overcome the

contradictions in which Aristotle had found himself in relation to matter and movement.

Strato, who was head of the Lyceum from 287 to 267 B.C., can be considered the father of scientific experiment.

According to Polybius, he earned the nickname "The Physicist," which at that time denoted anyone interested in the investigation of nature. Cicero says, in a disapproving tone, that he "abandoned ethics, which is the most necessary part of philosophy, and devoted himself to the investigation of nature" (ibid, p. 182). In 1893, Hermann Diels analysed a fragment attributed to Hero of Alexandria, the *Pneumatics*, written in

the second half of the 1st century A.D., which clearly lays down the basis of the experimental method worked out by Strato.

The scientists of the Alexandrine period made great advances in all fields of knowledge. In mechanics, for example, they produced mathematical explanations of a whole host of operations: the lever, the balance, the pulley, the potter's wheel, the wedge, the oars of a boat, the problem of inertia, etc. In the field of botany, the work of Theostratus remained without parallel until modern times, according to Farrington. Strato is now considered to be the author of the document

Mechanical Problems, originally attributed to Aristotle, which contains the germ of an important principle of mechanics, the principle of virtual velocities (the principle of virtual displacements). Erastheneis calculated the circumference of the earth, using scientific methods, and appears to have come within 0.4% of the correct result. Hero of Alexandria even invented a steam engine, although it could not be put to use. The question invariably arises in our minds why such extraordinary discoveries did not lead to a technological and industrial revolution 2,000 years ago. The answer to this question lies in the nature of the slave economy itself.

In general, with certain exceptions like mining, war engines and public works, the rulers of Greece and Rome were uninterested in the application of scientific discoveries for practical purposes. In the period when slavery became the dominant mode of production, the divorce between science and technology was almost total. Philosophical and scientific speculation was regarded as an intellectual pastime for the wealthy. Philosophers and mathematicians looked with contempt at the men of practical affairs. Euclid, the great geometrician, when asked by an incautious pupil what he would gain by studying geometry, ordered a slave to give him a few coins, "since he must

make a gain out of what he learns." In point of fact, no practical use was found for Euclid's theories until the 17th century, when Galileo discovered that projectiles move in parabolas and Kepler found that planets move in ellipses.

With an abundance of cheap slave labour, there was no incentive to move towards labour-saving technology. The market for refined products was restricted to a small class of wealthy people. The question of mass production therefore did not arise. Even in agriculture, which in the later period of Roman history was based on large-scale latifundia, there was a disincentive to

introduce machinery. First, because of the abundant supply of slaves, and second, because the slaves, unlike free labourers, could not be relied upon to look after delicate and costly machines. In a perceptive footnote in the first volume of *Capital*, Marx explains the reason for the impossibility of introducing advanced technology on the basis of slavery:

"This is one of the circumstances that makes production by slave labour such a costly process. The labourer here is, to use a striking expression of the ancients, distinguishable only as *instrumentum vocale*, from an animal as *instrumentum semi-vocale*, and from an implement as

instrumentum mutum. But he himself takes care to let both beast and implement feel that he is none of them, but is a man. He convinces himself with immense satisfaction, that he is a different being, by treating the one unmercifully and damaging the other con amore. Hence the principle, universally applied in this method of production, only to employ the rudest and heaviest implements and such as are difficult to damage owing to their sheer clumsiness. In the slave-states bordering on the Gulf of Mexico, down to the date of the civil war, ploughs constructed on old Chinese models, which turned up the soil like a hog or a mole, instead of making furrows, were alone to be found. (Conf.

J. E. Cairnes, *The Slave Power*, London, 1862, p. 46 sqq.) In his *Sea Board Slave States*, Olmsted tell us: "I am here shown tools that no man in his senses, with us, would allow a labourer, for whom he was paying wages, to be encumbered with; and the excessive weight and clumsiness of which, I would judge, would make work at least ten per cent greater than with those ordinarily used with us. And I am assured that, in the careless and clumsy way they must be used by the slaves, anything lighter or less rude could not be furnished them with good economy, and that such tools as we constantly give our labourers and find our profit in giving them, would not last out a day in a Virginia cornfield—

much lighter and more free from stones though it be than ours. So, too, when I ask why mules are so universally substituted for horses on the farm, the first reason given, and confessedly the most conclusive one, is that horses cannot bear the treatment that they always must get from Negroes; horses are always soon foundered or crippled by them, while mules will bear cudgelling, or lose a meal or two now and then, and not be materially injured, and they do not take cold or get sick, if neglected or overworked. But I do not need to go further than to the window of the room in which I am writing, to see at almost any time, treatment of cattle that would ensure the immediate discharge of

the driver by almost any farmer owning them in the North." (Capital, Vol. 1, p. 196, note.)

The rise of slavery undermined the free peasantry, crushed by military service, debt, and the competition of slavery. Paradoxically, the productivity of slave-labour was lower than that of the small peasants they displaced. But with a huge supply of slaves from foreign wars of conquest, the low level of productivity of the individual slave was compensated for by the cheapness of labour power of a large number of slaves subjected to forced labour. The replacement of small peasant holdings by vast latifundia, worked by armies of slaves, gave rise to

huge surpluses, as long as the supply of cheap slaves continued. Where slavery is the main mode of production, the very concept of labour becomes debased, identified in men's minds with all things base and degraded. No wonder Aristotle could not stomach Anaxagoras' theory that human intelligence depended on the hands!

This is not the place to analyse in detail the contradictions of the slave mode of production, which finally led to its demise. Suffice it to note that, despite the common attempt to compare the slave system with modern capitalism, in many ways it was the exact opposite. For example, the proletariat, which

today, along with nature, produces all the wealth of society, in the period of the Roman empire was a parasitic class, which lived on the backs of the slaves. On the other hand, whereas the modern capitalist depends on the continual search for avenues of reinvestment, the possibilities for investment open to the Roman capitalist were limited by the nature of slave production itself.

The key to the expansion of the productive forces under present-day capitalism is the production of the means of production, the manufacture of new machines, which leads to a constant increase in capital. In Antiquity, however, the conditions for the

development and application of machinery were lacking. The first of these is the existence of a large class of free labourers, who are compelled to sell their labour power to the owners of industry. There was no incentive to invent machines which could not be put to practical use. The relatively small class of craftsmen devoted themselves to the production of luxury articles for the gratification of the wealthy who, unlike the modern capitalists, having no productive outlet for their surpluses, devoted themselves to conspicuous consumption on a grand scale.

The entire system began to break down when the supply of cheap slave labour

dried up, as the empire reached its limits. In the absence of a revolutionary overturn, the whole of society entered into a prolonged phase of decline and decay. The barbarian invasions did not cause the collapse, but were an expression of the fact that the system of slavery had exhausted itself. The all-pervading sense of decay affected the outlook of every class. The feeling of weariness, of moral decadence, of disgust with a world that had outlived itself, finds its expression in the prevailing philosophies of the period—the words for two of them, cynicism and scepticism, have passed into the vocabulary of our own times, although with meanings completely different to

the originals.

The cynics were followers of Diogenes of Antisthenes, a pupil of Socrates, who professed his open contempt for all existing morals and customs. His more famous disciple, also named Diogenes, from Sinope, carried this idea to the extreme of wishing to live "like a dog," hence the word "cynic" (from the Greek word for a dog). It is said that he lived in a barrel. The idea, like that of present-day "drop-outs," was to reduce one's dependence on material things to a minimum. According to legend, when Alexander the Great offered him anything he wanted, he answered, "step out of my light." The whole idea, in

contrast to the modern cynics, was to despise worldly things.

This idea of turning away from the world to seek spiritual salvation in oneself reflected the profound social and cultural crisis caused by the decline of the Greek city-states. Even Pythagoras and Plato, despite their idealist philosophy, did not actually renounce the world entirely. Both tried to influence it by trying to persuade rulers to put their philosophical views into practice. Both appealed to logic and reason. What we see here is something different. A complete renunciation of this world, and a total denial of the possibility of knowing anything.

While the Lyceum produced important scientific results, the Academy fell increasingly under the influence of scepticism. The sceptic philosophy, represented by Pyhrro, Sextus Empiricus and others, questioned the possibility of objective knowledge of reality. "We can never know anything, not even that we know nothing." This was their central tenet. It was, to some extent, the logical outcome of the method of deduction, which was held up by the idealists as the only means of arriving at the truth, not by reference to the real world of observation and experiment, but by deriving ideas from other ideas, axioms and "first principles," like those of Euclid in geometry, which are regarded

as self-evident, and in no need of proof.

Sceptics like Timon denied the possibility of finding such principles. Everything had to be proved by something else, and that in turn by something else, and so on ad infinitum. And therefore, nothing can be known.

This marks a degeneration from objective idealism, which, for all its defects, was capable of reaching some important conclusions, to subjective idealism, the lowest, most primitive and sterile form of idealism. Ultimately, it leads to solipsism, the notion that only "I" exist. Everything depends on my subjective impressions. There is no

objective truth. For example, I cannot assert that honey is sweet, only that it seems sweet to me. To most people this seems absurd. But it is basically no different to the views later put forward by Hume and Kant, which have been widely accepted by modern bourgeois philosophers and scientists. For example, the idea advanced by the sceptics that you cannot say anything for certain about the world, but only that certain things are "probable" is the philosophical basis for a false interpretation of the results of quantum mechanics put forward in our own century by Werner Heisenberg and others and uncritically assimilated by many scientists.

Ideas like this do not drop from the clouds. They are the indirect and confused reflection in men's brains of an existing social reality. Scepticism in all its guises, including the modern ones, is the expression of a period in which a particular form of society has entered into irreversible decline, when the old ideals are breaking down, but the new ones have not yet asserted themselves. A general mood of uncertainty and malaise spreads through society, beginning with the educated layer, which feels it has lost its bearings. The most common expression of such moods is precisely scepticism, the insistence upon the relativity of all human knowledge, doubt, agnosticism. In the 18th century,

the period of the revolutionary ascent of the bourgeoisie, the scepticism of Montaigne and others played a progressive role in criticising the religious dogmas of the theologians. However, the scepticism of Hume and Kant, which attempted to place a limit on the possibilities of human understanding, opened the door to the re-entry of religious faith. Not accidentally, it is this latter variant which has been taken over by modern bourgeois philosophy, in the guise of logical positivism.

The common feature of all these philosophies of the period of decline of slave society is the idea of a retreat from

the world. It is the philosophy of despair. The world is seen as a vale of tears, from which it is necessary to escape, seeking individual salvation by various means. In the period of decline of the Roman empire, the philosophies of Epicureanism and Stoicism, dominant from the 1st century A.D. displayed the same tendency, although, as often happens, there was frequently a discrepancy between theory and practice. For example, Seneca, the stern moral philosopher of stoicism, who taught ethics to the emperor Nero, made a fortune out of lending money at exorbitant rates of interest, which provoked the rebellion of Bodicea against the Romans in Britain. This

prophet of poverty left behind one of the biggest fortunes of the time—300 million sesterces.

In his masterly study of Antiquity, *The Foundations of Christianity*, Karl Kautsky describes the intellectual and moral climate in which these ideas took root:

"Epicurus called philosophy an activity that brings about a happy life by means of concepts and proofs. He believed this would be achieved by striving for pleasure, but only for rational lasting enjoyment, not for transitory sensual dissipations, which lead to the loss of health and wealth, and hence to pain.

"This was a philosophy very well suited to a class of exploiters that found no other employment for their wealth than to consume it. What they needed was a rational regulation of the life of enjoyment. But this theory gave no consolation to those, and their number kept growing, who had already suffered bodily, spiritual or financial shipwreck; nor to the poor and wretched, nor to the satiated, those who were revolted by pleasures. And not to those who still had an interest in the traditional forms of the community and still followed goals beyond their own personality, those patriots who grieved to see the decline of state and society, without being able to prevent it. For all these groups the

pleasures of this world seemed stale and vain. They turned to the Stoic doctrine, which valued not pleasure but virtue as the highest good, as the only blessedness, and held external goods, health, wealth, etc., to be matters just as indifferent as external evils.

"This ended by leading many people to turn away from the world altogether, to despise life, even to long for death. Suicide became common in Imperial Rome; it actually became fashionable." (Kautsky, *op. cit.*, p. 89.)

Here we stand on the threshold between philosophy and religion. A society which has exhausted itself economically,

morally and intellectually finds its expression in a general mood of pessimism and despair. Logic and reason provide no answers, when the existing order of things is itself shot through with irrationality. Such circumstances are not conducive to the growth of scientific thought and bold philosophical generalisations. They are much more likely to produce an inward-looking tendency, reflecting social atomisation, mysticism and irrationality. From this world we can expect nothing, and even understand nothing. Far better to turn our backs on it, and prepare ourselves for a better life to come. In place of philosophy, we have religion, in place of reason, mysticism.

We already see this phenomenon in the period of decline of the Greek city-states when, in the words of Professor Gilbert Murray, "Astrology fell upon the Hellenic mind as a new disease falls upon some remote Pacific island people." (Quoted by Russell, p. 237.) The same phenomenon was multiplied a thousandfold in the long drawn-out decline of the Roman empire. The epidemic of Oriental religions and cults which afflicted Roman society at this time is well documented—not just Christianity and Judaism, but the cult of Mithras, the cult of Isis and Osiris, and a thousand other exotic sects proliferated at the expense of the official religion.

Many of these cults had similar ceremonies and rituals. The sacrament of Mithras included a sacred meal, in which consecrated bread and a chalice of wine were served to the faithful in anticipation of the future life. In fact, many elements of Christianity were taken over from other religions, and most of its doctrines from pagan philosophers. A special role was played by Plotinus (205-270), the Greek mystic and founder of the neo-Platonist school. Here we have the final decadence of classical idealism. The world is supposed to consist of the One, which is unknowable and inexpressible. We can only know it by mystical means, ecstatic communion, trances, and the like. This,

in turn, is achieved through the mortification of the flesh, and the emancipation of our better self from the bondage of matter. Plotinus sets out from the idea of a Holy Trinity. Matter has no independent reality, but is the creation of the soul. The only question is, why the soul bothered to create such stuff in the first place. But one is not supposed to ask such questions here, only to accept it as a "mystery." All this was taken over, bag and baggage, by the early Christian apologists, who produced a theology which is the bastard child of Oriental religion and Greek idealism in the period of its decadence. Such was to become the staple diet of European culture for 2,000 years, with the most

negative results for science.

The Struggle Against Religion

In the absence of a revolutionary alternative, the breakdown of slave society, produced a frightful collapse of culture, the effects of which lasted for centuries. In the period known as the Dark Ages, the scientific and artistic achievements of Antiquity were largely lost. The flame of learning was kept alight in Byzantium, Ireland and, above all, in the part of Spain occupied by the Arabs. The rest of Europe remained sunk in barbarism for a long time.

Gradually, a new form of society emerged from the wreckage of the old,

the feudal system, based on the exploitation of a peasantry who were no longer slaves, but were tied to the land, under the domination of temporal and spiritual lords. The pyramidal structure of society reflected this domination, with a rigid system of alleged duties and rights to one's "natural superiors." The fundamental duty, however, upon which everything else depended, was the duty of the serf to provide free labour service for his lord and master. This is what distinguishes this form of society from chattel slavery that went before it, and capitalism that followed it. The whole thing was sanctified by the Church, which wielded immense power, and was organised along similar hierarchical

lines.

The static, unchanging character of the feudal mode of production, and the rigid social hierarchy that rested upon it, found an ideological expression in the fixed dogmas of the Church, which demanded unquestioning obedience, based on the official interpretation of the sacred texts. The earlier doctrines of the Christians, with their strong revolutionary and communist overtones were persecuted as heresy, and stamped out, once Christianity became accepted as the state religion. In place of reason, the Church Fathers preached blind faith, summed up in the celebrated phrase attributed to Tertullian, "Credo, quia

absurdum est"—(I believe because it is absurd). Science was looked on as suspicious, a heritage of paganism. One of the last of the Greek mathematicians, Hypatia, was stoned to death by a mob led by a monk.

The heritage of classical Greek philosophy was lost, and was only partially revived in Western Europe in the 12th century. Such a situation was not conducive to the development of thought and science. "The conditions of feudal production reduced the demand for useful science to a minimum," writes J. D. Bernal. "It was not to increase again till trade and navigation created new needs in the later Middle Ages.

Intellectual effort was to go in other directions and largely in the service of a radically new feature of civilisation—organised religious faiths." (Bernal, Science in History, p. 181.)

According to Forbes and Dijksterhuis:

"Generally speaking it may be said that during the first centuries of its existence Christianity was not conducive to scientific pursuits. Science was regarded with suspicion because of its pagan origin; moreover, the ideal prevailed that it was not advisable for the spiritual welfare of Christians to penetrate more deeply into the secrets of nature than was made possible by the

Holy Scriptures and than was required to understand these." (Forbes and Dijksterhuis, A History of Science and Technology, Vol. 1, pp. 101-2.)

When the remnants of classical culture eventually reached Western Europe, it was in translations from the Arabic. The great energy shown by the Arabs in conquering North Africa and Spain right up to the Pyrenees was matched by their intelligent and flexible attitude to the culture of the conquered peoples, in marked contrast to the ignorant barbarism displayed by the Christians after the reconquest of Al-Andalus. For centuries, the Islamic universities in Spain, especially the one at Córdoba,

were the only real centres of learning in Europe, if we exclude Ireland, which, because of its remoteness, remained outside the mainstream. The Arabs made great advances in a whole number of fields—mathematics, astronomy, geography, medicine, optics and chemistry, as well as important technological advances, shown by the vast irrigation schemes which were wantonly destroyed by the Christians. But it took hundreds of years for this knowledge to percolate through to Western Europe.

Because of the Church's monopoly of culture, all intellectual life had to be channelled through it. At the universities,

where everything was taught in Latin, the curriculum was dominated by grammar, logic, rhetoric, arithmetic, astronomy and music. The high point was philosophy and theology, which were closely related. For centuries, philosophy was seen as the "handmaiden of theology." Science was reduced to a bare minimum: "Arithmetic was numeration; geometry the first three books of Euclid; astronomy hardly got past the calendar and how to compute the date of Easter; and the physics were very remote and Platonic." (Ibid., p. 218.) No interest was shown in scientific research and experiment.

Philosophy was reduced to an

impoverished form of Platonic idealism, later replaced by a completely ossified and one-sided reading of Aristotle. In the early period, St. Augustine (354-430) based himself on Neo-Platonism to attack the pagan opponents of Christianity. Much later, the writings of St. Thomas Aquinas (1225-74) represent a falsification of Aristotelian philosophy to fit the needs of the Church in the conditions of feudal society, playing down the materialist elements and stressing the weak side of Aristotle, the "unmoved first mover" and so on. To this day, a variant of his philosophy (neo-Thomism) remains the basic position of the Roman Catholic Church.

However, even in such apparently infertile soil, the seeds of further development slowly began to germinate. The mediaeval scholastics, or Schoolmen, who endlessly debated questions of theology in order to provide their religious world outlook with some theoretical basis, eventually produced a number of thinkers who were beginning to draw materialist conclusions. Not by accident, the most prominent of them came from Britain, where the roots of empiricism have traditionally run deep.

In the later Middle Ages, the rise of the towns and trade saw the emergence of a new and vigorous element in the social equation. The rising class of wealthy

merchants began to flex its muscles, demanding rights. The expansion of commerce, the opening up of new trade routes, the rise of a money economy, the creation of new needs and the means of satisfying them, the development of arts and crafts, the rise of a new national literature, all these things heralded the birth of a revolutionary force in society, the bourgeoisie, whose interests laid in breaking down the artificial feudal barriers which impeded its development, and also, to an ever-increasing extent, in developing and exploiting technical innovations.

The development of open-sea navigation, for example, demanded the

production of new and better charts, based on accurate astronomical observations, and also of more advanced navigational instruments. The introduction of paper and printing had a revolutionary effect on the accessibility of ideas which had earlier been limited to a tiny minority of ecclesiastics. The production of literature written in the vernacular for the first time had the same effect, with the emergence of great recognisable national writers, Boccaccio, Dante, Rabelais, Chaucer and finally, Luther. The introduction of gunpowder not only revolutionised warfare, and helped undermine the power of the nobles, but also gave a new impetus to the study of physics and

chemistry.

First in Italy, then in Holland, Britain, Bohemia, Germany and France, the new class began to challenge the old order, which, after nearly a thousand years, had exhausted itself and entered a phase of decline. The endless wars and civil wars of the period bore witness to the impasse of feudalism. The Black Death, which decimated the population of Europe in the 14th century, hastened the dissolution of feudal relations on the land. The peasant "jacqueries" in France and the Peasant Rising in England were a warning of the approaching dissolution of the feudal order. To many people, it seemed that the end of the world was

approaching. In fact, the sensation of impending doom which gave rise to phenomena like the flagellant sects, groups of religious fanatics, who travelled the country, whipping and otherwise inflicting pain on themselves, in anticipation of the impending Day of Wrath. This was merely a confused reflection in the popular imagination of the impending break-up of the existing social order.

The breakdown of a social system is anticipated by a crisis of the official morality and ideology, which increasingly enters into conflict with the changed social relations. A critical spirit arises among a layer of the intellectuals,

always a barometer of the tensions building up within the depths of society. An ideology and morality which no longer reflects reality is one that has outlived itself, and is destined to be overthrown. The moral and ideological basis for the feudal system was the teaching of the Church. Any serious challenge to the existing order meant an assault on the Church, which defended its power and privileges with all the means at its disposal, including excommunication, torture and the stake. But no amount of repression can preserve an idea whose time has past.

The Middle Ages are usually depicted as a time of extreme religious devotion

and piety. But that description certainly does not apply to the period under consideration. The Church, a wealthy and powerful institution which weighed heavily on the back of society, was widely discredited. "Of all the contradictions which religious life of the period presents," writes Huizinga, "perhaps the most insoluble is that of an avowed contempt of the clergy, a contempt seen as an undercurrent throughout the Middle Ages, side by side with the very great respect shown for the sanctity of the sacerdotal office...Hence it was that nobles, burghers and villeins had for a long time past been feeding their hatred with spiteful jests at the expense of the incontinent monk and the

guzzling priest. Hatred is the right world to use in this context, for hatred it was, latent, but general and persistent. The people never wearied of hearing the vices of the clergy arraigned. A preacher who inveighed against the ecclesiastical state was sure of being applauded. As soon as a homilist broaches this subject, says Bernardino of Siena, his hearers forget all the rest; there is no more effective means of reviving attention when the congregation is dropping off to sleep, or suffering from heat or cold. Everybody instantly becomes attentive and cheerful." (J. Huizinga, *The Waning of the Middle Ages*, p. 172-3.)

The undercurrents of dissent were felt

even within the Church itself, reflecting the pressures of society. Heretical movements like the Albigenses were put down in blood. But new oppositional trends appeared, sometimes disguised in the garb of mysticism. A 19th century Italian historian relates:

"The same spirit of reformation which animated the Albigenses had spread throughout Europe: many Christians, disgusted with the corruption and vices of the clergy, or whose minds revolted against the violence on their reason exercised by the church, devoted themselves to a contemplative life, renounced all ambition and the pleasures of the world, and sought a new road to

salvation in the alliance of faith with reason. They called themselves cathari or the purified; paterini, or the resigned." (Sismondi, A History of the Italian Republics, p. 66.)

The Dominican and Franciscan orders were founded in the early 12th century to combat heresies, anti-clericalism and new philosophical ideas. Sismondi says of Pope Innocent the Third: "He founded the two mendicant orders of Franciscans and Dominicans; new champions of the church, who were charged to repress all activity of mind, to combat growing intelligence, and to extirpate heresy. He confided to the Dominicans the fearful powers of the inquisition, which he

instituted: he charged them to discover and pursue to destruction the new reformers, who, under the name of paterini, multiplied rapidly in Italy." (Ibid., p. 60.)

Violent repression of opposition of any kind was a constant feature of the conduct of the ecclesiastical authorities from the highest level, as the history of the papacy shows. Pope Urban the Sixth, when he could not get the support of his cardinals, resolved the problem by the simple expedient of accusing them of conspiracy against him. He had many cardinals put to the torture in his presence, while he calmly recited his rosary. Others he ordered to be put in

sacks and drowned in the sea. The reforming monk Girolamo Savonarola, an Italian precursor of Luther, was tortured until he confessed all the crimes attributed to him, and burnt alive with two other monks. Examples can be multiplied at will.

The development of science was held back for hundreds of years by the stifling of thought by the spiritual police of the Church. The not inconsiderable intellectual energies of the Schoolmen were dissipated in endless and complicated debates on such subjects as the sex of angels. Nobody was permitted to go beyond the limits laid down by Church dogma, and those who attempted

to do so laid themselves open to harsh reprisals.

It therefore called for great courage when the English scholastic Roger Bacon (c. 1214-92), went so far as to challenge the Schoolmen's dogmatism and veneration of authority. Going against the spirit of the times, and anticipating the scientific method, he advocated the experimental study of nature. Given the fact that science had still not separated itself from alchemy and astrology, it is not surprising that elements of these were present in Bacon's writings. Nor is it surprising that he was rewarded for his boldness by being dismissed from teaching at

Oxford and confined to a monastery for his heretical views. In the circumstances, he was lucky.

The philosophical trend known as nominalism, which emerged at this time, stated that universal concepts are only names of individual objects. This reflected a move in the direction of materialism, as Engels explains:

"Materialism is the natural-born son of Great Britain. Already the British Schoolman Duns Scotus, asked, 'whether it was impossible for matter to think?'

"In order to effect this miracle, he took refuge in God's omnipotence, i.e., he

made theology preach materialism. Moreover, he was a nominalist. Nominalism, the first form of materialism, is chiefly found among the English Schoolmen." (Engels, Anti-Dühring, p. 427.)

The nominalist trend was developed by another Englishman (though, to be exact, Duns Scotus, as his name implies, was born either in Scotland or in Northern Ireland) William of Occam (died 1349), the most important of the Schoolmen. Occam maintained that the existence of God and other religious dogmas could not be proved by reason, and were founded solely upon faith. This was a dangerous doctrine, since it would mean

separating philosophy from religion, enabling it to develop separately, freed from the dead hand of the Church. Occam was excommunicated in 1328, but escaped from the Pope's territory in Avignon, and fled to the protection of Louis, King of France, who was also excommunicated. Louis then appealed to a general Council, and the Pope found himself accused of heresy. It is said that when Occam met the Emperor he said to him: "Do you defend me with the sword, and I will defend you with the pen." At bottom, this was not an abstract debate about philosophy, but the reflection of a life and death struggle between the Church and Emperor, and between France, England and Germany.

While containing the germ of a correct materialist idea, the philosophy of nominalism was mistaken in assuming that general concepts ("universals") are only names. In fact, they reflect real qualities of objectively existing things, which, apart from their particular features, also embody within themselves elements of the general, which identify them as belonging to a specific genus or species. This denial of the general and insistence on particulars is a peculiar feature of the empirical cast of mind which has characterised the Anglo-Saxon philosophical tradition ever since. As a reaction against the sterile idealist doctrines of the mediaeval Church, it represented an important

advance, a step in the direction of scientific experiment:

"It will not be surprising that thinkers entertaining nominalistic or related conceptions exerted a favourable influence on the study of science. Nominalism predisposed to attention for the experience of concrete things to be gained through the senses, whereas the opposite doctrine known as platonic realism (a confusing name, because it held that reality lay in ideas, so that it might also have been called idealism) always implied the temptation to aprioristic speculation." (Forbes and Dijksterhuis, op. cit., Vol. 1, p. 117.)

Nominalism is the germ of materialism, but a one-sided and superficial materialism which later led to a philosophical dead-end with Berkeley, Hume and the modern semantic philosophers. At the time, however, it represented a huge advance. Occam was the last of the great scholastics, but his approach encouraged a new generation of thinkers, like Nicholas of Oresme, his pupil, who investigated planetary theory. He anticipated Copernicus by considering the geocentric theory, which places the earth at the centre of the universe, and comparing it with the heliocentric theory, which states that the sun is at the centre, and concluding that either theory would serve to explain all

the known facts, and that, therefore, it was impossible to choose between them. This apparently cautious conclusion was, in fact, quite a bold step, since it put a question mark over the orthodox position of the Church, and thereby challenged its whole world outlook.

The cosmology of the mediaeval Church formed an important part of its general world outlook. It was not a secondary issue. The picture of the universe was supposed to be a mirror-image of the world, with the same kind of static, unchanging character, the same rigid hierarchy. It was not derived from observation, but taken over from the cosmology of Aristotle and the

Alexandrines, and accepted dogmatically. Bernal comments:

"The hierarchy of society was reproduced in the hierarchy of the universe itself; just as there was the pope, bishops, and archbishops, the emperor, kings, and nobles, so there was a celestial hierarchy of the nine choirs of angels: seraphim, cherubim, thrones; dominations, virtues, and powers; principalities, archangels, and angels (all fruits of the imagination of the pseudo Dionysius). Each of these had a definite function to perform in the running of the universe, and they were attached in due rank to the planetary spheres to keep them in appropriate

motion. The lowest order of mere angels that belonged to the sphere of the moon had naturally most to do with the order of human beings just below them. In general there was a cosmic order, as social order, an order inside the human body, all representing states to which Nature tended to return when it was disturbed. There was a place for everything and everything knew its place." (Op. cit., p. 227.)

This view of the universe could not be challenged without calling into question the entire world-outlook of the Church, and the type of society it defended. The conflict around the ideas of Copernicus and Galileo were not abstract

intellectual debates, but a life and death battle between opposing views of the world, which ultimately reflected a desperate struggle between two mutually exclusive social orders. The future of world history hinged upon the outcome.